

## SECTION 7. PROJECT DRAWINGS

7.1 GENERAL: The basic criteria for the preparation of drawings are contained in MIL-HDBK-1006/1, "Policy and Procedures for Construction Drawings and Specification Preparation". See Appendix C. In accordance with Deputy Assistant Secretary of Defense memo of 28 Dec 95, all new contracts should require drawings be submitted in CADD format. Refer to PACNAVFACENGCOM "Metric Guide for Contract Document Preparation" for metric units (SI International).

7.2 60% DRAWINGS: Drawings brought to a level of completion to sufficiently delineate the scope of work and give a strong indication of what is expected on the final design. The architectural and engineering drawings shall be developed to a uniform level so that the entire project can be reviewed for conformance with authorized scope and appropriate design criteria. Show all major items of work to preclude any "surprises" at the 100% submission. Include, as appropriate:

### 7.2.1 Civil:

7.2.1.1 Site Data: Based on a 100% complete field survey.

7.2.1.2 Location Map: Clearly show the location of the activity (station, camp, base, etc.) in a map of the region or State. If the activity is on a small island, such as Diego Garcia, show the island and the surrounding continents. For Hawaii projects, only the island on which the activity is located need be shown.

7.2.1.3 Vicinity Map: Clearly show the project site with the existing structures in the vicinity of the project. Show the routes the Contractor may use, from the main gate to the project site; this route will normally be the most direct route to the site. Where possible, school, housing, and other areas with a large number of people shall be avoided. Where applicable, show locations of borrow areas, disposal areas, Contractor storage areas or buildings.

### 7.2.1.4 Site Map:

a. Clearly show all structures, access roads, parking topography, survey control points, bench marks, drainage, roads and sidewalks, routing of water, sewer, gas, and other utilities. All new work shall be shown or indicated such that the reader can determine the entire scope of the kinds of construction involved by looking at this map.

b. Topographic data must extend sufficiently beyond the limits of new construction to demonstrate that the design drainage is adequate.

### 7.2.1.5 Boring Logs:

a. Cross Sections: Where earthwork cuts and fills are involved and are to be shown by cross sections, submit at least one drawing to show the method of presentation, scale, labeling, etc., proposed to be used.

#### 7.2.1.6 Plan and Profiles:

a. Provide plans and profiles of all utilities to show obstructions that will be encountered on the route and ensure the laying of pipe to the slope required by criteria is possible. Show manholes and lift stations required with capacities and critical elevations. Show connection points for utilities and points of discharge for culverts, blow off pipe, and pressure relief piping.

#### 7.2.2 Architectural:

7.2.2.1 Floor Plans: Show complete functional layout, room designations, major dimensions, critical dimensions, columns, and built-in equipment. Show/indicate fire rated walls and ceilings with graphic illustrations such as hatching or shading.

7.2.2.2 Elevations: Show openings, type and extent of building finishes, finished floor elevations, and finish grade at building.

7.2.2.3 Sections: Show relationship of various levels, floor-to-floor heights, typical wall sections, floor and roof framing, construction systems, materials, and basic details of any unusual features of construction.

7.2.2.4 Finish Schedule: Show proposed finishes.

#### 7.2.2.5 Area Tabulation:

- a. Show the net areas (square footage) for spaces.
- b. Show the gross building area by floors and total building. Delineate areas computed with small scale single line dimensioned drawings.
- c. Justification for deviation from areas or requirements contained in criteria or program, or deviation from approved concept drawings.

7.2.2.6 Preliminary Furniture Layouts: Show that adequate wall space, circulation area, etc., are provided to accommodate the intended use of the space as follows:

- a. Spaces requiring specific accommodations (example - 200 seat assembly room).
- b. Typical Bachelor Quarters (BQ) bedroom, showing location of wardrobes, and providing optional single and double bunking plans.
- c. Major spaces with multi-purpose use requirements which will require significantly different furniture arrangements for different uses.

d. Where building design will dictate special design furniture, schematic details sufficient to define nature and extent of special items should be included. This applies whether special design furniture items will be included in plans and specifications or procured as collateral equipment.

e. Repetitive spaces which form a major component of the design. (Show typical layout for BQ bedrooms, school classroom, etc.)

7.2.2.7 Embedment of Aluminum in Concrete: Do not embed aluminum conduit, pipe, bars, anchors, flashing, or other aluminum items in concrete.

#### 7.2.3 Structural:

7.2.3.1 Structural Systems: Show the type of structural system and kind of materials to be used. Include:

- a. Roof framing plan
- b. Floor framing plan
- c. Foundation layout plan

d. Design notes (live load, wind, seismic, etc., and materials design stresses).

7.2.3.2 Explosives Safety: Identify threat and give distance or negative statement.

#### 7.2.4 Mechanical:

##### 7.2.4.1 Equipment:

a. Location description, size and capacities of all mechanical equipment.

b. Large scale plan and sections of equipment rooms showing layout of equipment, ductwork, piping and adequate space around equipment for servicing.

##### 7.2.4.2 Systems:

a. Layouts of air conditioning or ventilation ductwork and piping systems. Ductwork shall be shown double line. Provide flows (CFM & GPM) at each outlet.

- b. Plumbing fixtures and isometric or riser diagrams.
- c. System and control diagrams for mechanical systems.
- d. Routing and capacities of distribution systems.

#### 7.2.4.3 Documentation:

- a. Energy analysis and studies.
- b. Basis design and design analysis.
- c. Economic analysis and life cycle cost studies.

#### 7.2.5 Fire Protection:

##### 7.2.5.1 Mechanical Systems:

- a. Label drawings FPM-1, etc.
- b. Sprinkler system drawings shall be performance oriented drawings, i.e., specific pipe runs, head locations, hanger details, etc., are not to be shown. Show underground pipe connection to street mains; sprinkler riser location and minimum size; a riser detail; and legend notes indicating hydraulic design point(s) along with available water supply data.
- c. Fire pump drawings will show equipment layout; pipe layout and minimum pipe sizes; pumps; drivers; control panels; water flow meter size and location; diesel fuel details, etc.; legend notes to indicate minimum equipment requirements; and adequate space around equipment for servicing.
- d. Carbon dioxide and/or Halon drawings shall show minimum cylinder sizes and locations; control panels locations; manual pull station locations; audible alarm devices associated with control panel(s); pertinent details showing wall or floor openings to be sealed up or automatically shut upon actuation; matrix logic diagram for detection and system operation including interlocks or equipment shutdowns; legend notes to indicate minimum design criteria including a comment on leakage design considerations.
- e. Dry or wet chemical systems showing equipment layouts, nozzle locations, manual actuation stations, minimum system capacities, legend notations to indicate minimum system design parameters including whether or not the ventilation system will be shut down upon actuation of the dry or wet chemical system.

##### 7.2.5.2 Electrical Systems:

- a. Label drawings FPE-1, etc.
- b. Evacuation alarm system plan showing location and minimum quantities of control panel(s), manual actuation stations, alarm horns, heat detectors, smoke detectors, duct smoke detectors; plus legend notations indicating Class A or B circuit supervision, zoning data, equipment interlock features and a matrix logic diagram rather than an electrical single line riser diagram.

c. Hazardous electrical areas shall be specifically designated in terms of Class, Division, and Group. Boundary lines shall be indicated to differentiate between ordinary areas and areas defined as hazardous locations.

d. Weatherproof electrical notations shall be indicated for equipment exposed to outside atmosphere or areas inside of a structure where open head deluge systems are provided.

e. Type of smoke and/or heat detectors shall be indicated by notation.

f. Emergency power shutdown switches shall be shown on plans.

#### 7.2.5.3 Miscellaneous:

a. If structural steel columns are to be protected, legend notes and typical details shall be shown on FPM drawings.

b. If ground level or elevated water storage tanks are provided, plan and section views shall be shown on FPM drawings.

c. If spill containment is required for a flammable hazardous facility, appropriate details along with legend notes shall be shown on FPM drawings.

d. If rack storage is involved, details and/or notations of the racks (including heights, widths, aisle spaces, transverse and longitudinal flue spaces, elevation to top of rack, elevation to top of storage, type of shelving, type of fork lifts, type of automated storage system, etc.) shall be shown on FPM drawings.

e. If fire rated walls and ceilings are required, highlight with cross-hatching or heavy lines and refer back to architectural or engineering drawings.

#### 7.2.6 Electrical:

7.2.6.1 Power Source: Show a power one-line diagram for proposed power sources.

7.2.6.2 Connection Point: Show connection points for power, telephone, T.V., etc.

7.2.6.3 Equipment: Show location, size, and capacities of transformers.

7.3 100% DRAWINGS: 100% Drawings shall be complete and clear enough for a contractor to prepare a realistic bid estimate. The following procedure/situations will not be acceptable:

a. Submission of nearly complete set of drawings, with the intention to complete them during the Government review.

b. Submission of a unchecked set of drawings. Checking is an A-E responsibility and must be done prior to the 100% submission. Common discrepancies are:

- (1) Incomplete or incorrect numbering of drawings.
- (2) Missing professional registration stamps.
- (3) Missing essential cross-referencing targets.
- (4) Incomplete or missing details which were referred to by other drawings.
- (5) Missing dimensions or details critical to locate or detail a discipline specific component. An example would be the structural dimension required to locate special beams/columns required to support a unique architectural component.
- (6) Discrepancies between disciplines.
- (7) Differences in dimensions on different sheets for the same item of construction.
- (8) Illegible dimensions and details.

7.3.1 Survey Control: Complete horizontal and vertical survey control, identifiable on the ground with sufficient ties to the new construction to permit stake out. Except for small projects, provide a minimum of two bench marks. These must be in such locations as to insure that their elevations will remain unchanged during the construction period. Drawings must show bench mark descriptions, elevations, and datum. Do not use assumed data except as approved by the PDE.

7.3.2 Profiles: In addition to profiles normally required for roads, runways, taxiways and gravity pipelines, show profiles for pressure pipelines where interference with other subsurface utilities is possible. Show profiles for water mains 4 inches and larger.

7.3.3 Loading: Show roof and floor live load (uniform or wheel or other concentrated live loads) and wind velocity. Show earthquake zone and K, I, and C values of building(s) designed. Show design wheel loading for airfield pavements.

7.3.4 Basic Working Stresses: Show classes of concrete, f'c value, and location where different classes are to be used. Show location and size of reinforcing steel and structural steel. Indicate location and design stress in concrete block masonry. Show strength of reinforcing steel and structural steel. Also, show design stresses of other materials used in the structural design.

7.3.5 Foundations: Indicate design soil pressure for footings and design values for piles.

7.3.6 Stress Diagrams: Provide stress diagrams for trusses, trussed rafters and trussed frames, etc.

7.3.7 Fallout Shelter Information: Include on the first drawing for fallout shelters the following information:

a. Each designated fallout shelter area is clearly identified and meets or exceeds the current requirements as established by the Defense Civil Preparedness Agency, Washington, D.C.

<u>Shelter Area No.</u>	<u>Protection Factor</u>	<u>Capacity (No. of People)</u>
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(Tabulate each shelter area on drawings. Shelter areas should be crosshatched or otherwise designated on the architectural drawings.)

b. Date.

c. Department of Defense certificate serial number.

d. Name of certificate holder (printed).

e. Signature of certificate holder.

7.4 FINAL DRAWINGS: Complete with 100% review comments incorporated.

7.5 DRAWING SHEETS: Prepare drawings on 22" x 34" ANSI D Form. "F" size sheets are acceptable if project justifies it. See Figure 1 of Appendix R for standard drawing sheet size. (Refer to MIL-HDBK-1006/1, Policy and Procedures for Project Drawings and Specification Preparation for guidance.)

7.6 LETTERING: Use uppercase lettering. Vertical lettering is preferred. Lettering must be plain, free of adornment and legible. The minimum size lettering on project drawings shall be free-hand 5/32 (0.156) inch high and mechanical or computer graphics 1/8 (.125) inch high. Since the drawings are microfilmed and reproduced half-size for bidding purposes, lettering less than the dimensions listed above is difficult to read after reduction. The use of pencil or crayon shading or poche on the back of drawings will not reproduce satisfactorily after microfilming. Sections or areas normally denoted by poches shall be indicated by stippling, crosshatching, or other pattern indication. Markings shall be on the front of drawings.

7.7 SCALES:

7.7.1 Uniformity: Scales used shall be large enough to show clearly all details when reduced to half-size. For civil work contact the PDE for review of the scales proposed to be used. A common problem has been that scales too small to show existing and new work are frequently used. Scales

shall be uniform on drawings for a particular project and for a particular type of work. If necessary to maintain proper scale, divide plans of large buildings or structures into two or more sheets, with appropriate key plan and match lines.

7.7.2 Graphic Scales: See Appendix S, Figures 1, 2 and 3, for architectural, engineering and metric types of graphic scales; the scales shown in these figures are not to scale. Provide drawings with graphic scales located immediately to the left of the title block, with the words "Graphic Scales" directly over the scales.

#### 7.7.3 English System:

a. Floor plans and elevations: 1/4 or 1/8 (1/16 inch only on approval by PACNAVFACENGCOM) inch = 1 foot, except that mechanical drawings showing air conditioning ductwork and areas receiving extensive piping work shall be drawn at a scale not less than 1/4 inch per foot. Mechanical drawings of the general floor plans may be prepared at 1/8 inch scale with detailed areas at 1/4 inch per foot.

b. Architectural details: 3/4, 1 1/2, or 3 inches = 1 foot.

c. Molding sections and similar details: full size or half size.

d. Mechanical and electrical details: 1/2, 3/4, or 1 inch = 1 foot.

e. Structural details: 1/2, 3/4, or 1 inch = 1 foot (larger, if necessary).

#### 7.7.4 SI (Metric) System:

a. Metric Design Scale (Preferred):

<u>Metric Scale</u>	<u>Metric Scale Equivalent</u>	<u>Customary Ratio</u>	<u>U.S. Customary Scale Equivalent</u>
1:1	300 mm = 300 mm	1:1	Full size 12"=1'-0"
1:5	60 mm = 300 mm	1:4	Close to 3" = 1'-0"
1:10	30 mm = 300 mm	1:8	Close to 1 1/2"= 1'-0"
1:20	15 mm = 300 mm	1:20	Close to 5/8" = 1'-0"
1:25	12 mm = 300 mm	1:24	Close to 1/2" = 1'-0"
1:50	6 mm = 300 mm	1:48	Close to 1/4" = 1'-0"
1:100	3 mm = 300 mm	1:96	Close to 1/8" = 1'-0"
1:200	meter	1:192	Close to 1/16" = 1"-0"
1:250	meter/kilometer	1:240	Close to 1" = 20'-0"
1:300	kilometer	1:300	Close to 1"= 25'-0"
1:500	kilometer	1:480	Close to 1" = 40'-0"
1:1000	kilometer	1:960	Close to 1" = 80'-0"

b. Drawing Scale

(1) Plans:



Site Plans

Civil facility site plans: 1:250 (1" = 20'-0") min.

Architectural site plans: 1:250 (1" = 20'-0") min.

Area/regional plans - Convert meters to kilometers when appropriate

Building Plans

Floor, roof, and ceiling plans: 1:100 (1/8" = 1'-0") min.

Detail Plans

Floor, roof, and ceiling plans : 1:50 (1/4" = 1'-0") min.

(2) Elevations:

Building Elevations

Exterior and interior elevations: 1:100 (1/8" = 1'-0") min.

1:50 (1/4" = 1'-0") pref.

Detailed Elevations

Exterior and interior elevations: 1:25 (1/2" = 1'-0") min.

(3) Sections:

Building Sections

Longitudinal and transverse sections: 1:50 (1/4"=1' - 0") min.

Detailed Sections

Wall, floor, and roof sections: 1:25 (1/2" = 1'-0") min.

Interior finish, cabinets, and equipment: 1:25 (1/2"=1'-0") min.

(4) Details:

Building Details

Floor, wall, and roof : 1:25 (1/2" = 1'-0") min.

Doors, windows, and cabinets: 1:10 (1 1/2" = 1'-0") min.

Miscellaneous: 1:25 (1/2" = 1'-0") min.

7.7.5 Plot Plans and General Layouts: Scales for general layouts shall be as follows:

a. Plot or layout plans: 1 inch = 10, 20, 40, 60, 100, or 200 feet.

b. Location plans: 1 inch = 40, 60, 100, or 200 feet.

c. Utility plans: 1 inch = 20, 30, or 40 feet.

d. Cross sections and profiles: exaggerated scales to show conditions.

7.7.6 Maps and Surveys:

- a. General: 1 inch = 100, 200, or 500 feet.
- b. Site planning: 1 inch = 200 feet.
- c. Detailed design: 1 inch = 20, or 40 feet.

7.8 USE OF PASTE-ONS AND STICK-ONS: Do not use adhesives, decals, paste-ons, or stick-ons on original drawings unless vellum or mylar replacement is made. In this case the original is destroyed and the replacement becomes the new original.

7.9 NAVFAC DRAWING NUMBERS: NAVFAC Drawing Numbers can be obtained from the PACNAVFACENGCOM Plan Files when the total number of sheets in a contract has been firmly established, generally near the time for 100% submittal.

7.10 PACNAVFACENGCOM SKETCH NUMBERS FOR IFB/RFP/SEI PACKAGES: Sketch numbers for existing condition or requirements drawings for Invitation for Bids (IFB), Request Fee Proposal (RFP), and Site Engineering Investigation (SEI) projects shall be obtained from PACNAVFACENGCOM Plan Files. Note: Applicable to only drawings without NAVFAC numbers.

7.11 CONSTRUCTION CONTRACT NUMBER AND SPECIFICATION NUMBER: The construction contract and specification numbers will be in the "SCOPE." Do not confuse the construction contract number with the A-E contract number.

7.12 SHEET NUMBERS: In numbering the sheets, show the basic sheet number and the total number of drawings on ALL sheets. For example, if there are a total of 130 sheets in the set of drawings, the first sheet should bear "Sheet 1 of 130" and the last sheet "Sheet 130 of 130".

7.13 DESIGNATION OF TYPE OF DESIGN: Use "A-1", "M-1", "FP-1", "ENV-1", etc., as designations for architectural, mechanical, fire protection, environmental, etc., drawings. Place these designations outside and adjacent to the title block as shown in Figures 2 and 3 of Appendix R, and use in conjunction with MIL-HDBK-1006/1, Figure 1, Symbols to Identify Sections, Elevations, and Details.

7.14 DRAWING REVISIONS:

7.14.1 Space for Revisions: The revision block location, size, and format shall be as shown in Appendix R.

7.14.2 Revision Block Notations: Indicate revisions by alphabetical sequence starting with the letter "A". Revisions made on a certain date shall have the same revision letter associated with it. (Example: Revisions made on 15 Feb 00 shall only have the revision letter "C" associated with it.) EXAMPLE:

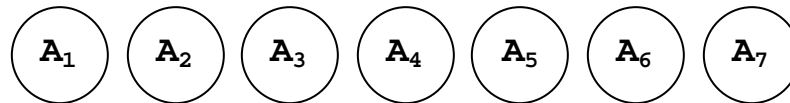
<u>DRAWING A-1</u>	<u>DRAWING A-2</u>	<u>DRAWING M-4</u>
C            2/15/00	C            2/15/00	

B	2/1/00	B	2/1/00	B	2/1/00
A	1/1/00				

Each revision must be approved by PACDIV, as indicated by an authorized signature (initials) in the "Approval" block. Identify each revision on the drawing by a capital letter and numerical subscript enclosed in a circle:

Using "Rev. A" as an example:

a. Each revision made on the drawing shall have a circled A with a numerical subscript placed in the lower right-hand side of the A within the circle. Number these A's consecutively, starting with a numerical subscript 1. If 7 A's are placed on the drawing, there shall be 7 little indicator numbers, the last one being number "7," i.e.:



The A placed on the revision block shall have a numerical subscript placed in the lower right of the A indicating the total number of circled A's placed on the drawing; in this example, A<sub>7</sub>. (This letter and numerical subscript need not be circled due to the narrow space in the revision block.) It makes it possible for the construction Contractor to glance at the revision block and tell how many circled A's are indicated on the drawing.

b. The number(s) of the A's indicating that particular type of work shall be placed before the description of that work under the "Description" heading in the revision block, i.e.:

<u>LTR</u>	<u>DESCRIPTION</u>	<u>Date</u>
(e.g. 1 <sup>st</sup> sheet)		
<b>A<sub>7</sub></b>	1 & 2 Revise gutter details; 3 & 4 Revise road alignment between Stations 1+00 and 2+00; 5, 6, & 7 add guys to pole line	10 Jan 00
(e.g. 2 <sup>nd</sup> sheet)		
<b>A<sub>3</sub></b>	1, 2, & 3 Add plaster finish to exterior concrete masonry walls	10 Jan 00
(e.g. 3 <sup>rd</sup> sheet)		
<b>A<sub>2</sub></b>	1 & 2 Increase duct sizes from 4 x 12 to 12 x 12	10 Jan 00

c. Clouding: Use of clouding is permissible. If a revision is in the same area, delete original (old) clouding and show new clouding for new revision. Keep circle(s) with the old revision letter(s) with numerical subscript(s) on the drawing.

7.14.3 Formal Approval of Revised CADD Generated Drawings: When a CADD generated drawing is revised after formal approval signatures have been placed on the original drawing, the following policy is provided to ensure proper approvals have been received:

a. For all revisions, update the CADD file on the computer and plot a new PDF drawing file. Since the new PDF drawing does not have the stamped information, signatures and dates, use the following procedure:

1) The new CADD generated original drawing shall supersede the past original drawing that has been revised. Include a note in the new CADD generated original drawing's revision block stating:

"THIS DRAWING SUPERSEDES DRAWING DATED XX/XX/XX"

The date used shall be the Commander, NAVFAC previous approval date.

2) Reuse the same NAVFAC drawing number for the new drawing.

3) Route the new PDF drawing for new formal approval electronic signatures. Signatures shall be made by the current approval authorities and with current dates.

7.15 INDEX OF DRAWINGS: Provide an Index of Drawings on the cover/title sheet of the drawings. If the Index to Drawings for a set of drawings separately identifies architectural, structural, electrical, and mechanical drawings, then also identify civil engineering drawings separately. These include those showing surveys, demolition, grading, drainage, paving, water supply, sewerage, erosion control, landscaping, and irrigation sprinkler systems.

7.16 ARRANGEMENT OF DRAWINGS: Arrange drawings in the order listed below. A cover sheet with large lettering of only the title and location of the project is not required or desired.

a. Title Sheet and index of drawings (applicable only for large projects containing a number of drawings of each discipline).

b. Plot plan, vicinity map, and drawing list (including civil and utility plans). This sheet should include index of drawings for small projects.

c. Civil engineering drawings, including topographic survey, survey control, demolition, grading, drainage, paving, water supply, sewerage, and erosion control.

d. Landscape and irrigation (sprinkler system).

e. Architectural drawings (including interior design).

f. Structural drawings.

- g. Mechanical drawings.
- h. Electrical drawings.
- i. Communications drawings.
- j. Fire protection drawings.
- k. Environmental drawings.

7.17 DELINEATION OF NEW WORK: Show new work by heavy lines and existing features by light lines.

7.18 DELINEATION OF BID ITEMS: On the drawing title sheet, include a written description of each bid item included in the project, starting with Bid Item 1. On each of the sheets that has a bid item identified, also include a written description of the work associated with the bid item shown on that sheet. Refer to Appendix R for a sample of bid items depicted on the drawing title sheet and drawing sheet.

7.19 PROFESSIONAL REGISTRATION STAMP: The stamp and signature of a registered professional architect or engineer, who is a principal of the A-E firm, is required on the first sheet of the drawings. The first sheet of each design discipline's drawings, such as Civil, Architectural, Structural, Mechanical, Fire Protection, and Electrical, shall also be stamped and signed by the appropriate registered professional architect or engineer. Sheet C-1 should be stamped by a registered civil engineer, Sheet A-1 should be stamped by a registered architect, etc. For sewage treatment plants and other unique type designs, ensure that the letter designation of the type of design per paragraph 7.13 coincides with the appropriate design discipline. In addition to the professional registration stamps, an officer of the principal A-E firm (or a partner, if the firm is a partnership) shall also sign every drawing in the title block in the space marked "Submitted By." THE A-E'S ATTENTION IS CALLED TO THE CONTRACT CLAUSE ENTITLED "REQUIREMENTS FOR REGISTRATION OF DESIGNERS (APR 1984)." Appendix B.

7.20 ENVIRONMENTAL DRAWINGS: Environmental drawings shall be stamped by the registered architect or engineer who prepared the drawings. Drawings will be listed after the Fire Protection drawings and be designated by "ENV-1", "ENV-2"... "ENV-16", etc.

7.21 AMENDMENT TO ADD NEW DRAWINGS: The A-E shall add the new numbers and titles to the original Title Sheet/Index Sheet in Plan files. Penciled in numbers and titles are permissible. If there are a lot of new drawings, then prepare a new Title Sheet/Index Sheet.

7.22 AMENDMENT TO ADD SKETCHES: The A-E shall indicate in the revision block of the original Title Sheet/Index Sheet in Plan Files the sketch numbers that have been added.